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Research Article

Risk Factors of Venous Thromboembolism in Polytrauma Patients: A Single Centre Report

Khalid A Mowafy[1]*, Samir M Attia[1], Mohamed E Awad[1], Mohamed Alghandour[2], Mona A Abd Elghani[3] and Mohamed El Said[3]

[1]*Vascular Surgery Department, Mansoura College of Medicine, Mansoura University, Egypt*

[2]*General Surgery Department, Mansoura College of Medicine, Mansoura University, Egypt*

[3]*Mansoura Emergency Medicine and Critical Care Unit, Mansoura Emergency Hospital, Mansoura College of Medicine, Mansoura University, Egypt*

***Corresponding Author:** Khalid Mowafy, Vascular Surgery Department, Mansoura College of Medicine, Mansoura University, Egypt.

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Abstract

Background and Objectives: Trauma is a major health problem and a leading cause of mortality and morbidity among young individuals in the world (World Health Organization, 2014). Complications that occur to trauma patients are associated with increased morbidity, length of stay, death and a significant financial cost. Venous thromboembolism (VTE) is a life threatening complication after trauma. It comprises Deep Venous Thrombosis (DVT) and pulmonary embolism (PE) and represents a significant cause of death, disability, and discomfort after trauma associated hospitalization. While DVT may present clinically silent, PE is the third most common cause of death in patients that survive first 24 hours after trauma. Frequency of VTE among hospitalized patient after trauma is ranging from less than 1% up to 58% depending upon the demographics of the study population, the nature of injury and other factors.

Materials and methods: This is a prospective observational clinical study carried out on 250 polytrauma patients with severe injuries who were admitted at Mansoura University Emergency Hospital Intensive Care Units (ICU): a level 1 trauma center with about 250,000 visits and 25000 trauma cases admission per year through one year from February 2018 to February 2019.

Results: This study was performed on 250 trauma patients who presented to Mansoura University Emergency Hospital and admitted at ICU to determine the risk factors of VTE in polytrauma patients. The studied patients were divided into 2 main groups. The studied patients who developed VTE [41.6% (n=104)] were termed VTE group, while the patients who didn't develop VTE [58.4% (n=146)] were termed non-VTE group. The outcome in the 2 study groups was determined in relation to the ICU length of stay, ventilation rate and period, and survival rate. These three items showed high significant statistical differences ($p < 0.01$) between VTE and non-VTE groups. Regarding the ICU length of stay: it was more prolonged in VTE group than non-VTE group (11.98 ± 2.9 and 9.75 ± 2.78 days respectively); the ventilation rates were more in VTE group than non-VTE group (79.8% and 54.1% respectively) and their periods were more prolonged in VTE group than non-VTE group (9 ± 4.3and 6 ± 4.1days respectively), while the survival rate was much lower in VTE group than non-VTE group (77.9% and 91.1% respectively).

Conclusion: The incidence of VTE is affected by the body region injured: head and extremities due to subsequent post-traumatic stress disorder, prolonged immobility and delayed VTE prophylaxis regimen initiation.

Operations and injury severity represent the most important risk factor for VTE development.

The presence of VTE is associated with a significant increase in mortality mainly due to the deleterious impact of PE and negative outcome.

VTE may be subtle in presentation as it may be asymptomatic with sudden deterioration and circulatory collapse.

Keywords: Risk Factors; Venous; Patients

Introduction

Venous thromboembolism (VTE) is a life threatening complication after trauma. It comprises Deep Venous Thrombosis (DVT) and pulmonary embolism (PE) and represents a significant cause of death, disability, and discomfort after trauma associated hospitalization. While DVT may present clinically silent, PE is the third most common cause of death in patients that survive first 24 hours after trauma. Frequency of VTE among hospitalized patient after trauma is ranging from less than 1% up to 58% depending upon the demographics of the study population, the nature of injury and other factors [1].

DVT rates vary by anatomical region injured ranging from 50% in patients with abdominal thoracic or facial injury to 80% in patients with femur fracture (Whiting., *et al*. 2016). Numerous risk factors for DVT have been reported in polytrauma patients including age, injury severity, fracture of pelvis, femur, tibea and spinal cord injury, central vein cannulation, medical comorbidities including DM and obesity [2].

Both chemical, mechanical thromboprophylaxis have been shown to decrease Rate of VTE in trauma patients. Pharmacologic prophylaxis with low molecular weight - heparin (LMWH) Was shown to significantly decrease incidence of both DVT, PE in trauma patients and mechanical prophylaxis with pneumatic sequential compression Devices (SCDs) significantly decrease incidence of VTE from 4% to 11% in trauma patients compared to Patient with no VTE prophylaxis [3].

Materials and Methods

Patients:

Study design

This is a prospective observational clinical study carried out on 250 polytrauma patients with severe injuries who were admitted at Mansoura University Emergency Hospital Intensive Care Units (ICU): a level 1 trauma center with about 250,000 visits and 25000 trauma cases admission per year through one year from February 2018 to February 2019.

Inclusion criteria: all of the following

- All age groups.
- Both genders.
- Polytrauma patients admitted to Mansoura University Emergency Hospital ICU.
- Abbreviated Injury Score (AIS) ≥3 in at least 1 body region.

Exclusion criteria: any of the following

- Pregnant patients.
- Patient on anticoagulant therapy.
- Patient with severe debilitating diseases.
- Patient with complicated blood diseases.
- Patient who do not wish to participate in the study.
- Hepatic patients.

Methods

Resuscitation and primary survey of all patients

A = Airway and cervical spine stabilization as there is risk of coexistent cervical spine injury. So, manual cervical spine stabilization or neck collar should be considered. Are there signs of airway obstruction, foreign bodies, facial, mandibular or laryngeal fractures? Management may involve secretion control, intubation or surgical airway (e.g., cricothyroidotomy, emergency tracheostomy).

B = Breathing and ventilation: Provide high flow oxygen through a rebreather mask if not intubated and ventilated. Evaluate breathing: lungs, chest wall and diaphragm. Chest examination with adequate exposure: inspect, palpate, percuss and auscultate to detect lesions that are acutely impairing ventilation.

C = Circulation and control of hemorrhage: Blood loss is the main preventable cause of death after trauma. Two wide bore cannulas should be inserted and blood sample should be sent to the lab.

To assess blood loss, rapidly observe

- Level of consciousness.
- Pulse.
- Skin color.
- Capillary refilling time.
- Obvious bleeding.

D = Disability and rapid neurological assessment:

- Pupils: size, symmetry and reaction to light.
- Any lateralizing signs.
- Hypoglycemia may all also affect the level of consciousness.

E = Exposure and environmental control including undressing the patient, but prevent hypothermia. Clothes are needed to be cut off but, after examination, try to prevent heat loss with warming devices, warmed blankets, etc.

Adjuncts of primary survey including monitor, pulse oximetry, urinary catheter, Focused Assessment Sonography in Trauma (FAST), Chest X-ray (CXR) and x-ray pelvis were done.

Treatment priority	Necessary procedure
Airway	1. Jaw thrust/chin lift 2. Suction 3. Intubation 4. Cricothyroidotomy (with protection of cervical spine)
Breathing and Ventilation	1. Chest needle decompression 2. Tube thoracostomy 3. Supplemental oxygen 4. Seal open pneumothorax
Circulation and hemorrhage control	1. IV line/ central line 2. Venous cut down 3. Fluid resuscitation/Blood transfusion 4. Thorocostomy for massive hemothorax 5. Pericardiocentesis for cardiac tamponade
Disability	1. Burr holes for trans-tentorial herniation 2. IV mannitol
Exposure/Environment	1. Warmed crystalloid fluid 2. Temperature

Table 1: Primary survey (ABCDE approach) for life-threatening conditions management.

All patients will be subjected to

- Data and full medical history taking: age, gender, occupation, mode of trauma, time of trauma and time of arrival.
- AMPLE history (Allergy, Medications, Past History, Last meal, Environment).
- Secondary survey:

Clinical examination of the patients in resuscitation room including vital signs (pulse, blood pressure, respiratory rate and oxygen saturation), Glasgow coma scale and complete general examination (head-to-toe) examination with log-roll technique to identify possible occult injuries.

AIS in different body regions

Score	Injury
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Incompatible with life

Table 2: Abbreviated Injury Scale (AIS) [4].

Patients admitted to ICU were followed up for two weeks to assess risk factors of VTE.

When VTE was suspected by history and complaint, it was confirmed by focused clinical examination and instigations (laboratory and radiological):

History

- In PE: Shortness of Breath (SOB), rapid breathing, cough, coughing up blood, chest pain worsened by breathing.
- In DVT: unilateral limb pain, swelling, redness and limited movement.

Clinical examination

In PE

- Tachycardia.
- Tachypnea.
- The lungs are usually normal.
- Pleural friction rub may be audible over the affected area of the lung (mostly in PE with infarct).
- Decreased percussion note, audible breath sounds, and vocal resonance may be detected with pleural effusion.
- Left parasternal heave, a loud pulmonary component of the second heart sound, raised jugular venous pressure with right ventricular strain
- Low-grade fever may be present.
- In severe cases: cyanosis, hypotension may be present.

In DVT

- Unilateral limb swelling with circumference >3cm more than the other limb.
- Unilateral tenderness over the calf muscles.
- Visible distended superficial veins.

- Palpable tender cord along the course of the vein.
- Homan's sign: pain with dorsiflexion of the foot.

Pretest probability

In PE: Well's score

Clinical Features	Points
Symptoms of DVT (leg swelling and pain with palpation)	3
PE as likely as or more likely than an alternative diagnosis	3
HR >100 bpm	1.5
Immobilization for >3 consecutive days or surgery in the previous 4 weeks	1.5
Previous DVT or PE	1.5
Hemoptysis	1
Malignancy (receiving treatment, treatment stopped within 6 months, palliative care)	1

Table 3: Well's score for PE [5].

Score interpretation

- ≤ 4: PE unlikely (confirmed with D-dimer).
- ≥5: PE likely (confirmed with CT-pulmonary angiography).

In DVT: Well's score

Clinical features	points
Active cancer (treatment within last 6 months or palliative): point	+1
Calf swelling ≥ 3 cm compared to asymptomatic calf (measured 10 cm below tibial tuberosity)	+1
Swollen unilateral superficial veins (non-varicose, in symptomatic leg)	+1
Unilateral pitting edema (in symptomatic leg)	+1
Previous documented DVT	+1
Swelling of entire leg	+1
Localized tenderness along the deep venous system	+1
Paralysis, paresis, or recent cast immobilization of lower extremities	+1
Recently bedridden ≥ 3 days, or major surgery in the past 12 weeks	+1
Alternative diagnosis at least as likely	−2

Table 4: Well's score for DVT [6].

Score interpretation

- 0: low risk (unlikely).
- 1-2: moderate risk.
- ≥3: high risk.

Investigations

In PE:

- D-Dimer: only useful in low PE probability patient.
- ABG:
    - May be normal.
    - Low PaO2
    - Respiratory alkalosis.
    - High A-a gradient.
- ECG
    - May be normal.
    - Sinus tachycardia is most common finding
    - T-wave inversion in anterior/septal leads + inferior leads
    - Nonspecific ST changes, S1Q3T3 (develops due to strain on RV)
    - RBBB or new incomplete RBBB.
    - New right axis deviation
    - Atrial fibrillation
- CXR
    - May be normal.
    - Atelectasis is most common
    - Pleural effusion
    - Hampton's Hump
    - Westermarck's sign
- Transthoracic echo or bedside cardiac ultrasound
    - Can help diagnosis in equivocal cases
    - May see signs of right heart strain (bowing of septum into LV: D Sign)
    - McConnell's sign (akinesis of RV base/free wall with sparing of apex).
- CT-Pulmonary angiography
    - Gold standard for diagnosis.
    - Looking for filling defect and/or pulmonary infarction.

In DVT:

- D-Dimer
    - Only useful in low probability patients.
    - Negative D-dimer excludes DVT
    - Positive D-dimer: necessitates lower extremity Doppler ultrasound.
- Doppler ultrasound

- Used with moderate to high probability for DVT.
- Negative Doppler ultrasound with negative D-dimer excludes DVT.
- Negative Doppler ultrasound with positive D-dimer: repeat in 1 week.
- Positive Doppler ultrasound: confirm DVT.

- The studied patients were divided into two main groups: VTE group and non-VTE group.
- VTE patients will be further subdivided into three subgroups: DVT group, PE group and both DVT and PE group.
- The outcome will be assessed according to
  - Survival rate.
  - ICU length of stay (2 weeks).
  - Ventilation rate and its period.

Ethical consideration

Study protocol was submitted for approval by medical research ethics committee of Faculty of Medicine, Mansoura University, Egypt.

Informed written consent was obtained from each participant in the study after assuring confidentiality.

Results

This study was performed on 250 trauma patients who presented to Mansoura University Emergency Hospital and admitted at ICU to determine the risk factors of VTE in polytrauma patients. The studied patients were divided into 2 main groups. The studied patients who developed VTE [41.6% (n=104)] were termed VTE group, while the patients who didn't develop VTE [58.4% (n=146)] were termed non-VTE group as shown in table 5 and figure 1.

	Study group (n=250)	
	No	%
VTE	104	41.6%
Non-VTE	146	58.4%

Table 5: Distribution of the studied patients according to the incidence of VTE.

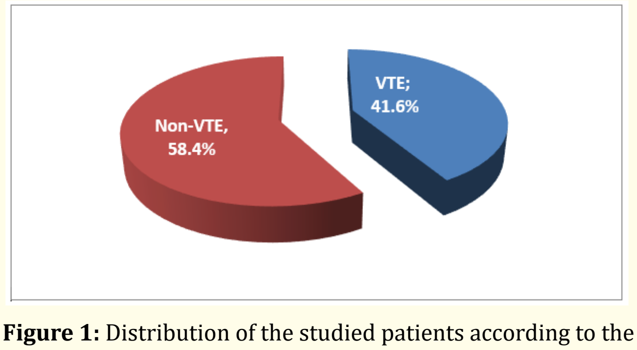

Figure 1: Distribution of the studied patients according to the presence of VTE.

The VTE group were further subdivided into 3 subgroups according the type of VTE that developed: DVT in 39.4% (41 patients), PE in 51.9% (54 patients), both DVT and PE in 8.7% (9 patients) as shown in table 6 and figure 2.

VTE subgroups	Study group (n=104)	
	No	%
DVT	41	39.4
PE	54	51.9
DVT + PE	9	8.7

Table 6: Distribution of post-traumatic VTE among the studied patients.

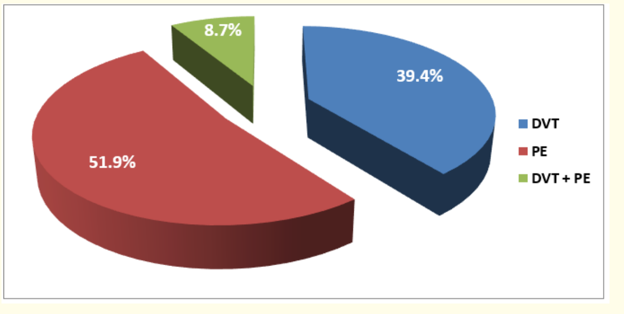

Figure 2: Types of VTE in the studied patients with post-traumatic VTE.

The demographic data (age and gender) showed no significant statistical differences between the 2 main groups. VTE group consisted of 75% (n=78) males and 25% (n=26) females, with 53.8% of them were <40 years and 46.2% were ≥40 years, with mean age of 26.4 ± 6.3 years. Non-VTE group consisted of 69.9% (n=102) males and 30.1% (n=44) females, with 59.6% of them were <40 years and 40.4% were ≥40 years, with mean age of 27.6 ± 7.4years as shown in table 7.

Demographic data	Study group (n=250)		
	VTE (n=104)	Non-VTE (n=146)	Test of sig.
Gender			
Male	78 (75%)	102 (69.9%)	$\chi2$= 0.561
Female	26 (25%)	44 (30.1%)	P = 0.4540
Age / y			
<40 y	56 (53.8%)	87 (59.6%)	$\chi2$= 0.6
≥ 40 y	48 (46.2%)	59 (40.4%)	P = 0.4384
Mean ± SD	26.4±6.3	27.6±7.4	t= 1.343 P = 0.1805

Table 7: Distribution of demographic data in both VTE and non-VTE groups.

Regarding the modes of trauma, blunt trauma was prevalent over penetrating trauma [90% (225 patients) and 10% (25 patients) respectively]. Blunt trauma was found in 91.3% of VTE group and 89% of non-VTE group. There was no significant statistical difference between the 2 main groups.

Mode of trauma		Study group (n=250)		
VTE (n=104)		Non-VTE (n=146)	Test of sig.	
Blunt	225 (90%)	95 (91.3%)	130 (89%)	$\chi 2 = 0.148$
Penetrating	25 (10%)	9 (8.7%)	16 (11%)	P = 0.7003

Table 8: Distribution of the modes of trauma among the studied patients.

Table 9 and figure 3 describe the correlation between trauma sites and their severity; according to AIS; to the incidence of VTE. Severe extremity injuries had high significant statistical difference (p <0.01) between VTE and non-VTE groups (79.8% vs. 50.7% respectively), severe head and pelvis injuries had significant statistical differences (p <0.05) between VTE and non-VTE groups (59.6% and 45.2% vs. 44.5% and 28.8% respectively), while thoracic, abdominal or spinal injuries showed no significant differences (p >0.05) between VTE and non-VTE groups.

Severe injury sites (AIS ≥3)	Study group (n=250)			
	VTE (n=104)	Non-VTE (n=146)	Test of sig. (χ2)	P value
Head	62 (59.6%)	65 (44.5%)	4.95	0.0261*
Thorax	85 (81.7%)	114 (78.1%)	0.299	0.5848
Abdomen	51 (49%)	63 (34.2%)	0.875	0.3495
Spine	29 (27.9%)	41 (28.1%)	0.0118	0.9135
Pelvis	47 (45.2%)	42 (28.8%)	6.449	0.0111*
Extremities	83 (79.8%)	74 (50.7%)	20.821	< 0.0001**

Table 9: Distribution of severe trauma sites (AIS ≥ 3) among the studied group.

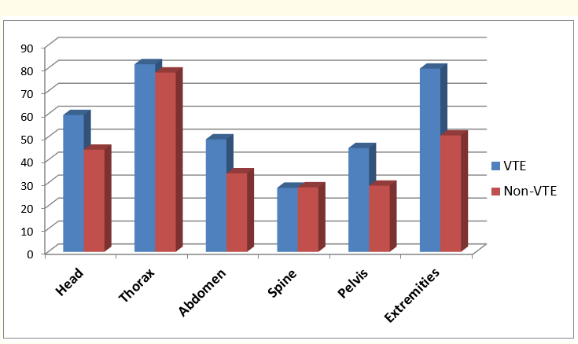

Figure 3: Severe injury sites distribution between the 2 main groups.

The anatomical distribution of severe injuries were variably distributed between the three groups of VTE: thorax in (85.4%, 77.8% and 88.9%), extremities in (68.3%, 88.9% and 77.8%), head in (43.9%, 66.7% and 88.9%), abdomen in (46.3%, 48.1% and 66.7%), pelvis in (34.1%, 51.8% and 55.6%) and spine in (26.8%, 27.8% and 33.3%) respectively. There were significant statistical differences (P <0.05) regarding head and extremities trauma as shown in table 10 and figure 4.

Severe injury sites (AIS ≥3)	DVT (n=41)	PE (n=54)	DVT + PE (n=9)	χ2	P - value
Head	18 (43.9%)	36 (66.7%)	8 (88.9%)	8.52	0.014*
Thorax	35 (85.4%)	42 (77.8%)	8 (88.9%)	1.23	0.539
Abdomen	19 (46.3%)	26 (48.1%)	6 (66.7%)	1.256	0.533
Spine	11 (26.8%)	15 (27.8%)	3 (33.3%)	0.156	0.925
Pelvis	14 (34.1%)	28 (51.8%)	5 (55.6%)	3.377	0.1848
Extremities	28 (68.3%)	48 (88.9%)	7 (77.8%)	6.160	0.046*

Table 10: Relation between VTE and site of trauma.

χ2: Chi square test * significant if P value <0.01

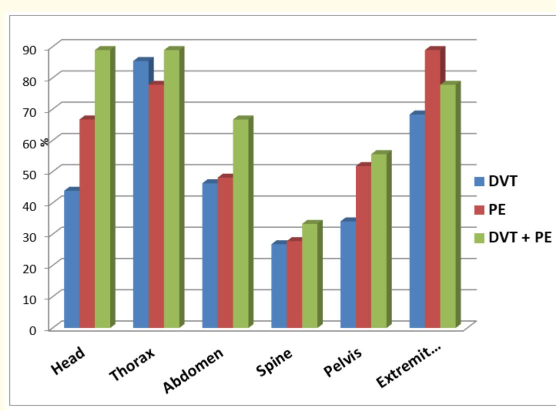

Figure 4: Relation between VTE and site of trauma.

The operations performed in the studied patients varied with high significant statistical difference (p <0.01) between the VTE group and non-VTE group. Approximately 96.2% (100 patients) of VTE patients had operations while only 47.3% (69 patients) of non-VTE patients had operations as shown in table 11.

The outcome in the 2 study groups was determined in relation to the ICU length of stay, ventilation rate and period, and survival rate. These three items showed high significant statistical differences (p <0.01) between VTE and non-VTE groups. Regarding the ICU length of stay: it was more prolonged in VTE group than non-VTE group (11.98 ± 2.9 and 9.75 ± 2.78 days respectively); the ventilation rates were more in VTE group than non-VTE group (79.8% and 54.1% respectively) and their periods were more prolonged in VTE group than non-VTE group (9 ± 4.3and 6 ± 4.1days respectively), while the survival rate was much lower in VTE group than non-VTE group (77.9% and 91.1% respectively). These results were demonstrated below in table 12.

Operations	**Study group (n=250)**			
	VTE (n=104)	**Non-VTE (n=146)**	**Test of sig. ($\chi2$)**	**P - value**
Yes	100 (96.2%)	69 (47.3%)	64.078	< 0.0001**
No	4 (3.8%)	77 (52.7%)		

Table 11: Operations performed in the studied patients and their distribution between the 2 main groups.

		VTE (n=104)	**Non-VTE (n=146)**	**Test of sig.**
ICU length of stay (days)		11.98 ± 2.9	9.75 ± 2.78	t= -6.140 P <0.001**
Ventilation	Rate: N. (%)	83 (79.8%)	79 (54.1%)	t= - 4.540 P < 0.0001**
	period (days)	9 ± 4.3	6 ± 4.1	
Survival	Died	23 (22.1%)	13 (8.9%)	$\chi2$=7.562 P = 0.006**
	Survived	81 (77.9%)	133 (91.1%)	

Table 12: Outcome variations between the 2 main groups.

Also, the outcome was studied in VTE subgroups. The 3 items of outcome showed high significant statistical differences (P <0.01) between VTE subgroups with worse outcome in patients with PE and both DVT and PE. Regarding the ICU length of stay, the mean values were (13.44 ± 3.36) in both DVT and PE group, (12.63 ± 2.54) in PE group and (9.88 ± 3) in DVT group. As regards ventilation rates: they were higher in PE then both DVT and PE then DVT (90.7%, 77.8% and 56.8% respectively) and their periods' mean values were (10.1 ± 3) in both DVT and PE group, (9.7 ± 2.9) in PE group and (7.3 ± 3.2) days in DVT group. Concerning survival, there were 77.9% (81 patients) survived [97.6% (40 patients) in DVT group, 64.8% (35 patients) in PE group, 66.7% (6 cases)] and 22.1% (23 patients) died [2.4% (1 patient) in DVT group, 35.2% (19 patients) in PE group, 33.3% (3 patients) in both DVT and PE group. These data are described below in table 13.

		DVT (n=41)	**PE (n=54)**	**DVT + PE (n=9)**	**Test of sig.**
ICU length of stay (days)		9.88 ± 3	12.63 ± 2.54	13.44 ± 3.36	t=-5.743 P <0.001**
Ventilation	N. (%)	27 (56.8%)	49 (90.7%)	7 (77.8%)	t=-6.264 P <0.001**
	period (days)	7.3 ± 3.2	9.7 ± 2.9	10.1 ± 3	
Survival	Died 23 (22.1%)	1 (2.4%)	19 (35.2%)	3 (33.3%)	$\chi2$=15.23 P<0.001**
	Survived 81 (77.9%)	40 (97.6%)	35 (64.8%)	6 (66.7%)	

Table 13: Analysis of outcome in the VTE subgroups.
$\chi2$: Chi square test t: Student t test
** High statistical significance if P value <0.01

Discussion

Trauma and critically ill patients are exceedingly susceptible to VTE events such as deep venous thrombosis (DVT) and pulmonary embolism (PE) as they are often prone to stasis by their immobility, have sustained endothelial injury from their trauma, and find their own immune system up regulated to a hypercoagulable state [7].

This study was conducted on 250 polytrauma patients with severe injuries who were admitted at our ICU. The studied patients were divided into 2 main groups: VTE group (104 patients developed VTE) and non-VTE group (where no VTE was detected in 146 patients). Among the VTE group, 41 patients (39.4%) had DVT, 54 patients (51.9%) had PE group, and 9 patients (8.7%) had both DVT and PE.

In a study accomplished by Carrillo and others (2018), a total of 6191 pediatric patients included in analysis with 97.7% (6171 patients) didn't develop VTE and 0.3% (20 patients) developed a VTE: 2 of them had PE, 17 patients had DVT and 1 patient had both PE and DVT [8].

In a former study conducted by Park and his colleagues (2016), a total of 570 trauma patients were involved. Of them, 200 developed post-traumatic VTE within 92 days after hospitalization, and 370 patients did not develop VTE. The distribution of VTE event types were DVT alone (n = 93), PE alone.

(n = 80) and PE with DVT (n = 27) [9].

In a previous study executed by Lichte and his workmates (2015), from a total of 40,846 trauma patients, 1122 (2.8%) patients developed VTE during their posttraumatic clinical course [DVT in 0.8% (313 patients); PE in 1% (425 patients); MI in 0.4% (160 patients) and stroke in 0.6% (231 patients) [10].

In an earlier study carried out by Malinoski and his collaborators (2013), a total of 918 trauma patients were involved. Of them, 411 met the criteria for the study by having an ICU LOS 2 days, duplex prior to leaving the ICU, and by not receiving chemical prophylaxis within the first 5 days of admission. 92.7% (381 patients) were without VTE and 7.3% (30 patients) developed VTE: 28 patients with DVT and 2 patients with PE [11].

Venous thromboembolic complications remain significant contributors to morbidity and mortality following traumatic injury. Despite the widespread adoption of venous thromboembolism prophylaxis protocols, incidence of DVT and PE are reported as high as 44% and 24% respectively during post-injury hospitalization in high risk patients [12].

In the current study, the demographic data including age and gender showed no significant statistical differences between patients with VTE and those without VTE. The VTE group consisted of 75% (n=78) males, with 46.2% were ≥40 years, with mean age of 26.4 ± 6.3 years. Non-VTE group consisted of 69.9% (n=102) males, 40.4% were ≥40 years, with mean age of 27.6 ± 7.4years

Likewise, Carrillo and others (2018) reported that there were no significant differences between non-VTE patients and VTE patients regarding age and gender. The mean age was 6.56 in non-VTE group and 6.72 in VTE group. The male percentage was prevailing in both non-VTE (63.4%) and VTE (60%) groups [8].

Furthermore, Malinoski and his collaborators (2013) stated that there were no significant differences regarding the demographic data between the non-VTE and VTE groups. The mean ± SD of age was 48 ± 23.6 in VTE and 45.6 ± 21.1 in non-VTE. Non-VTE group consisted of 71.7% males while the VTE group consisted of 80% males [11].

We are in concordance with Knudson and his coworkers (2004) who reported that the age range was from 1–90 years, with a mean of 39.6 years in all patients and a mean age of 49 years in VTE patients. Male gender represented 65% of the population. In patients with VTE, 69% were male [13].

In contrast, Park and his colleagues (2016) found that there was significant difference between VTE and non-VTE groups regarding age as the age ranges were 54-85 y and 33-81y respectively. The VTE group consisted of 40% males while the non-VTE group consisted of 37% males [9].

The most commonly implicated patients in trauma are males in their middle age because they often tend to participate in dangerous events as high speed drive and drive without wearing any protecting devices leading to increased frequency of exposure to motor car crashes which add more financial burden over the community [14].

In the present study, blunt trauma was the predominant mode of trauma as it was present in 90% (225 patients), while penetrating trauma was present in 10% (25 patients). Blunt trauma was found in 91.3% of VTE group and 89% of non-VTE group with no significant statistical difference between the 2 main groups.

We are in agreement with Lichte and his workmates (2015) who told that blunt trauma was the dominant mechanism in both VTE and non-VTE groups (96.1% and 95.3% respectively). In VTE subgroups: blunt trauma was present in 96.4% of DVT, 96.6% of PE, 96.8% of MI and 64.1% of stroke.Similarly, Malinoski and his collaborators (2013) stated that the blunt mechanism of trauma was prevalent in the non-VTE group and VTE group with no significant differences in between (83.5% and 90% respectively) [10,11].

Awareness of the mechanism of trauma is extremely important in the emergency department as certain mechanisms may provoke trauma team activation and may adjust further needs for additional radiological investigations, intervention or certain admission place. But, the mechanism of trauma cannot predict the outcome of trauma without meticulous examination and monitoring [15].

In the current study, there is strong correlation between trauma sites and their severity (calculated by AIS in different body regions) and the incidence of VTE. Severe extremity injuries showed high significant statistical difference (p <0.01) between VTE and non-VTE groups, severe head and pelvis injuries varied significantly (p <0.05) between VTE and non-VTE groups, while thoracic, abdominal or spinal injuries were closely approximated (p >0.05) in both VTE and non-VTE groups. Furthermore, there were significant differences in extremities and head injuries between the 3 subgroups with VTE.

We are in harmony Lichte and his workmates (2015) stated that comparison of injuries by different body regions didn't show any relevant differences in head/neck, chest, and abdomen regions between the VTE and non-VTE groups. However, there was a significantly higher rate of injuries in the extremities and especially pelvic body region of patients who sustained VTE (DVT and PE) when compared to non-VTE patients.

We are in agreement with Paffrath and others (2010) who found that VTE patients were more common and more severely injured than non-VTE patients when considering specific body regions (abdomen, pelvis and extremities with an AIS score 3) except for head (p = 0.011 for abdomen, p < 0.001 for pelvis and extremities).

Our results agree with Knudson and his coworkers (2004) who informed that the different injuries were significantly associated with VTE (P <0.01). The injuries found were lower extremity fracture (n=63508), head injury (n=52197), spinal cord injury with paralysis (n=2852) and pelvic fracture (n=2707).

In this study, operations were done in 96.2% (100 patients) of VTE patients in the studied patients while they were done only in 47.3% (69 patients) of non-VTE patients. There was high significant statistical difference (p <0.01) regarding operations in between the 2 main groups.

Likewise, Paffrath and others (2010) stated that there were high significant differences between both groups regarding operative procedures and their frequencies. In VTE group, 80.8% had ≥2 operations, 19.2% had 1 operation and 4.1% had no operations. In non-VTE group, 64.3% had ≥2 operations, 35.7% had 1 operation and 16.3% had no operations.

Similarly, Knudson and his coworkers (2004) reported that there was high significant statistical analysis regarding the operative procedures performed (P value <0.01). Major surgical procedures were performed in 73974 patients.

In contrast, Malinoski and his collaborators (2013) found that there was significant difference between non-VTE and VTE groups regarding pelvic fracture repair operations (3.1% and 13.3% respectively), while other operations as craniotomy, spine surgery, abdominal surgery and extremity surgery had no significant differences between the 2 study groups [(8.4% vs. 13.3%), (2.6% vs. 3.3%), (11% vs. 10%) and (12.6% vs.20%) respectively].

Venous thromboembolism (VTE) is a multifactorial disease where interactions between large numbers of different risk factors lead to the development of DVT or PE. Risk factors for VTE after injury have been well characterized, and include advancing age, long bone and pelvic fractures, spinal cord and traumatic brain injury, prolonged immobilization and delay of prophylaxis initiation. Surgery in general and orthopedic surgery in particular is however one of the most important single risk factors for DVT [16].

In the present study, the outcome in the 2 study groups was determined according to the ICU length of stay, ventilation (rates and periods) and survival. All showed high significant statistical differences (p <0.01) between VTE and non-VTE groups with obvious worse outcome was associated with VTE. The ICU length of stay and the ventilation rates were higher their periods were more prolonged in VTE group than non-VTE group, while the survival rate was much lower in VTE group than non-VTE group. Also, the worse outcome was associated with PE prevalence in the VTE subgroups. Too, there were significant statistical differences in the outcome 3 items between the 3 subgroups.

We are in agreement with Carrillo and others (2018) who found that there were high significant statistical differences regarding the outcome (admission LOS, ICU admission and intubation percentage). VTE patients were admitted for more prolonged period (21.19 vs. 5.817, p < 0.001), more likely to require an intensive care unit (ICU) admission (95% vs. 29.8%, p < 0.001), and require mechanical intubation (90% vs. 12.80%, p < 0.001).

Conclusion

- The incidence of VTE is affected by the body region injured: head and extremities due to subsequent post-traumatic stress disorder, prolonged immobility and delayed VTE prophylaxis regimen initiation.
- Operations and injury severity represent the most important risk factor for VTE development.
- The presence of VTE is associated with a significant increase in mortality mainly due to the deleterious impact of PE and negative outcome.
- VTE may be subtle in presentation as it may be asymptomatic with sudden deterioration and circulatory collapse.

Recommendations

- VTE prophylaxis should be initiated as early as possible and whenever possible in patients following severe traumatic injury or operations especially orthopedic trauma and operations.
- Duration of therapy is based on the severity of injury as well as the patients' associated VTE risk factors.
- Future studies with larger numbers of studied polytrauma patients should be performed for more evaluation and determination of variable risk factors involved in VTE development.
- Further studies and multicenter trials are needed to help refine the guidelines used for VTE risk assessment.
- The use of mechanical prophylaxis could be used when possible either as a supplement to prophylactic regimen or as an alternative to it.

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